PULMONARY FUNCTION TESTS

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INTRODUCTION

- Pulmonary function tests is a generic term used to indicate a battery of studies or maneuvers that may be performed using standardized equipment to measure lung function.

Evaluates one or more aspects of the respiratory system

  - Respiratory mechanics
  - Lung parenchymal function/ Gas exchange
  - Cardiopulmonary interaction

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INDICATIONS

DIAGNOSTIC	PROGNOSTIC
Evaluation of signs & symptoms- BLN, chronic cough, exertional dyspnea	Assess severity
Screening at risk pts	Follow response to therapy
Measure the effect of Ds on pulmonary function	Determine further treatment goals
To assess preoperative risk	Evaluating degree of disability
Monitor pulmonary drug toxicity	

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TISI GUIDELINES

- Age > 70
- Obese patients
- Thoracic surgery
- Upper abdominal surgery
- History of cough/ smoking
- Any pulmonary disease

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American College of Physicians Guidelines

- Lung resection
- H/o smoking, dyspnoea
- Cardiac surgery
- Upper abdominal surgery
- Lower abdominal surgery
- Uncharacterized pulmonary disease(defined as history of pulmonary Disease or symptoms and no PFT in last 60 days)

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Contraindications

- Recent eye surgery
- Thoracic , abdominal and cerebral aneurysms
- Active hemoptysis
- Pneumothorax
- Unstable angina/ recent MI within 1 month

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9. Tests of gas exchange function
10. Tests for cardiopulmonary reserve
11. Preoperative assessment of thoracotomy patients

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CATEGORIZATION OF PFT

MECHANICAL VENTILATORY FUNCTIONS OF LUNG / CHEST WALL:

- BED SIDE PULMONARY FUNCTION TESTS
- STATIC LUNG VOLUMES & CAPACITIES – VC, IC, IRV, ERV, RV, FRC.
- DYNAMIC LUNG VOLUMES –FVC, FEV1, FEF 25-75%, PEFR, MVV, RESP. MUSCLE STRENGTH

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GAS- EXCHANGE TESTS :

- A)Alveolar-arterial po2 gradient
- B) Diffusion capacity
- C) Gas distribution tests- 1)single breath N_2 test.2)Multiple Breath N_2 test 3) Helium dilution method 4) Radio Xe scinitigram.

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CARDIOPULMONARY INTERACTION:

- Qualitative tests:
  1) History , examination
  2) ABG
- Quantitative tests
  1) 6 min walk test
  2) Stair climbing test
  3)Shuttle walk
  4) CPET(cardiopulmonary exercise testing)

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Bed side pulmonary function tests

RESPIRATORY RATE

- Essential yet frequently undervalued component of PFT
- Imp evaluator in weaning & extubation protocols

Increase RR - muscle fatigue - work load - weaning fails

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Bed side pulmonary function tests

1) Sabrasez breath holding test:

Ask the patient to take a full but not too deep breath & hold it as long as possible.

- >25 SEC.-NORMAL Cardiopulmonary Reserve (CPR)
- 15-25 SEC- LIMITED CPR
- <15 SEC- VERY POOR CPR (Contraindication for elective surgery)

25- 30 SEC - 3500 ml VC

20 – 25 SEC - 3000 ml VC

15 - 20 SEC - 2500 ml VC

10 - 15 SEC - 2000 ml VC

5 - 10 SEC - 1500 ml VC

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Bed side pulmonary function tests

2) SCHNEIDER'S MATCH BLOWING TEST: MEASURES Maximum Breathing Capacity.

Ask to blow a match stick from a distance of 6" (15 cms) with-

- Mouth wide open
- Chin rested/supported
- No purse lipping
- No head movement
- No air movement in the room
- Mouth and match at the same level

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Bed side pulmonary function tests

- **Can not blow out a match**
  - MBC < 60 L/min
  - FEV1 < 1.6L
- **Able to blow out a match**
  - MBC > 60 L/min
  - FEV1 > 1.6L
- **MODIFIED MATCH TEST:**

DISTANCE	MBC
9”	>150 L/MIN.
6”	>60 L/MIN.
3”	> 40 L/MIN

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Bed side pulmonary function tests

3)COUGH TEST: DEEP BREATH F/BY COUGH

- ABILITY TO COUGH
- STRENGTH
- EFFECTIVENESS

INADEQUATE COUGH IF: FVC<20 ML/KG

FEV1 < 15 ML/KG

PEFR < 200 L/MIN.

*A wet productive cough / self propagated paraoxysms of coughing – patient susceptible for pulmonary Complication.

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Bed side pulmonary function tests

4)FORCED EXPIRATORY TIME:

After deep breath, exhale maximally and forcefully & keep stethoscope over trachea & listen.

N FET – 3-5 SECS.

OBS.LUNG DIS. - > 6 SEC

RES. LUNG DIS.- < 3 SEC

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Bed side pulmonary function tests

5)WRIGHT PEAK FLOW METER: Measures PEFR (Peak Expiratory Flow Rate)

N – MALES- 450-700 L/MIN.

FEMALES- 350-500 L/MIN.

<200 L/ MIN. – INADEQUATE COUGH EFFICIENCY.

6)DE-BONO WHISTLE BLOWING TEST: MEASURES PEFR.

Patient blows down a wide bore tube at the end of which is a whistle, on the side is a hole with adjustable knob.

As subject blows → whistle blows, leak hole is gradually increased till the intensity of whistle disappears.

At the last position at which the whistle can be blown , the PEFR can be read off the scale.

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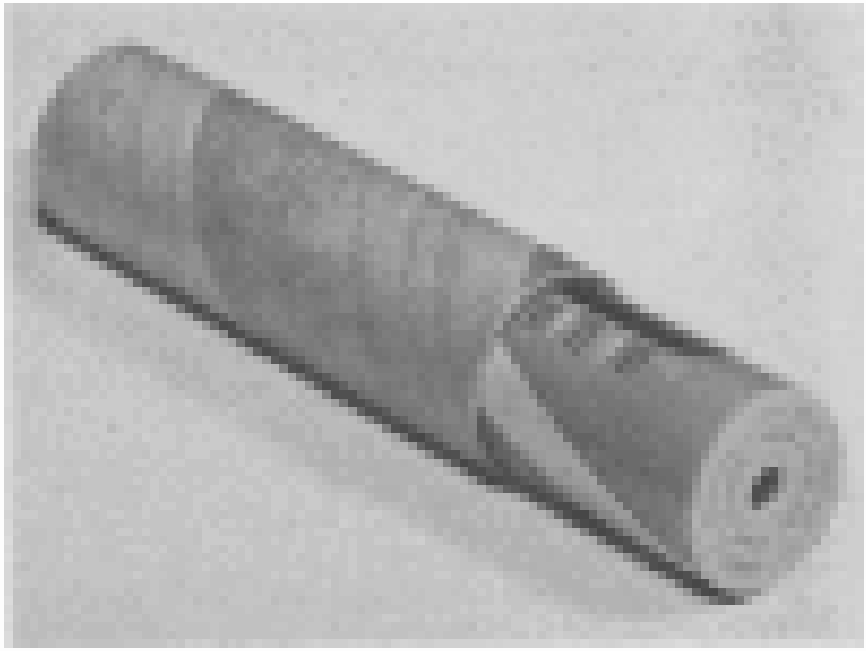
DEBONO’S WHISTLE



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Bed side pulmonary function tests

- **MICROSPIROMETERS** – MEASURE VC.
- **BED SIDE PULSE OXIMETRY**
- **ABG.**

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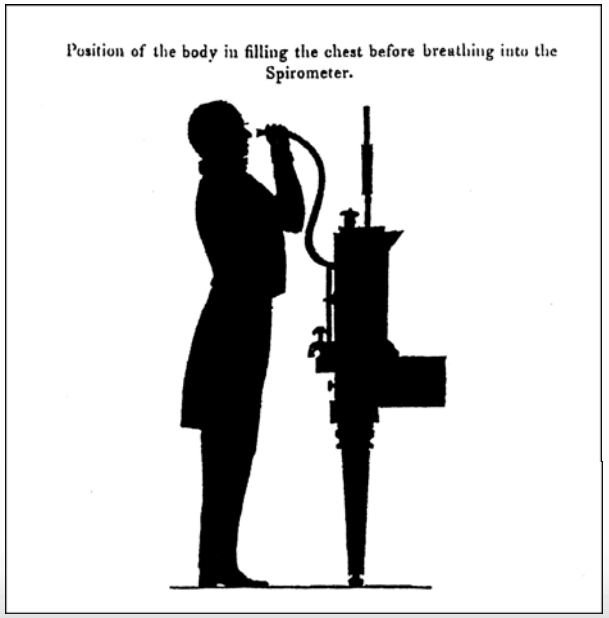
STATIC LUNG VOLUMES AND CAPACITIES

- **SPIROMETRY : CORNERSTONE OF ALL PFTs**.
- John hutchinson – invented spirometer.
- "Spirometry is a medical test that measures the volume of air an individual inhales or exhales as a function of time."
- CAN'T MEASURE – FRC, RV, TLC



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SPIROMETRY-Acceptability Criteria

- Good start of test- without any hesitation
- No coughing / glottic closure
- No variable flow
- No early termination(> 6 sec)
- No air leak
- Reproducibility- The test is without excessive variability

The two largest values for FVC and the two largest values for FEV_1 should vary by no more than 0.2L.

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SPIROMETRY-Acceptability Criteria

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Spirometry Interpretation: So what constitutes normal?

- Normal values vary and depend on:

I. Height – Directly proportional

II. Age – Inversely proportional

III. Gender

IV. Ethnicity

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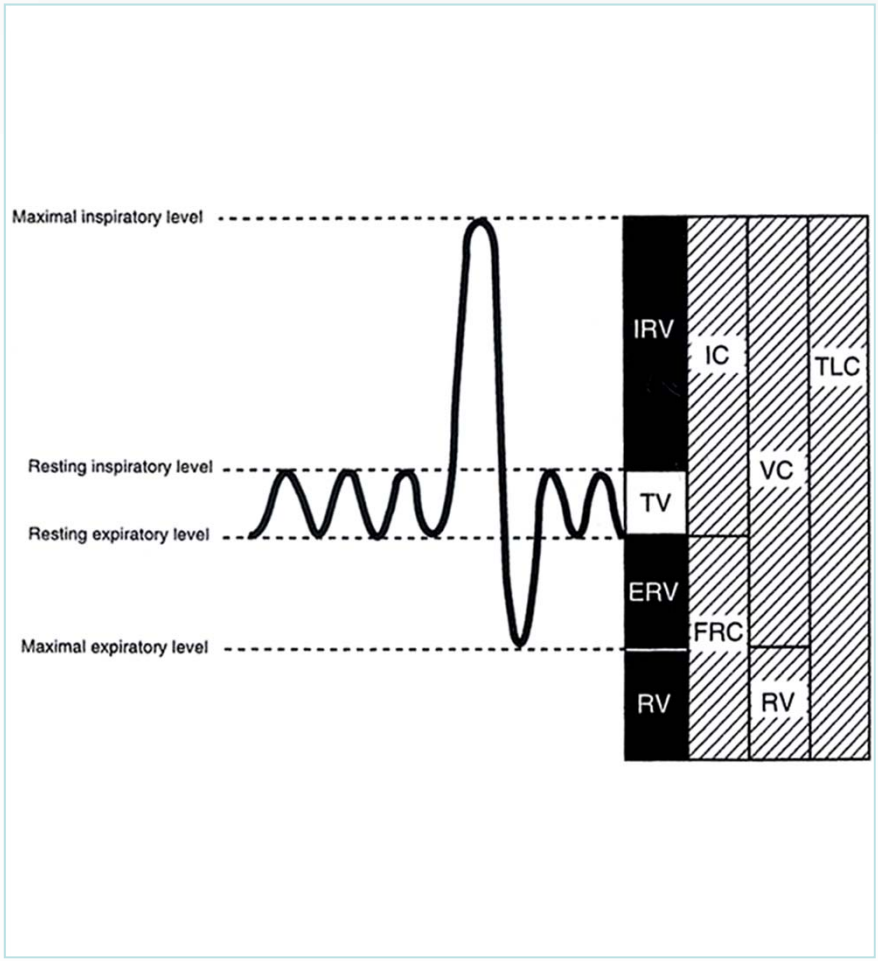
LUNG VOLUMES AND CAPACITIES



PFT tracings have:

- Four Lung volumes: tidal volume, inspiratory reserve volume, expiratory reserve volume, and residual volume

- Five capacities: inspiratory capacity, expiratory capacity, vital capacity, functional residual capacity, and total lung capacity

Addition of 2 or more volumes comprise a capacity.

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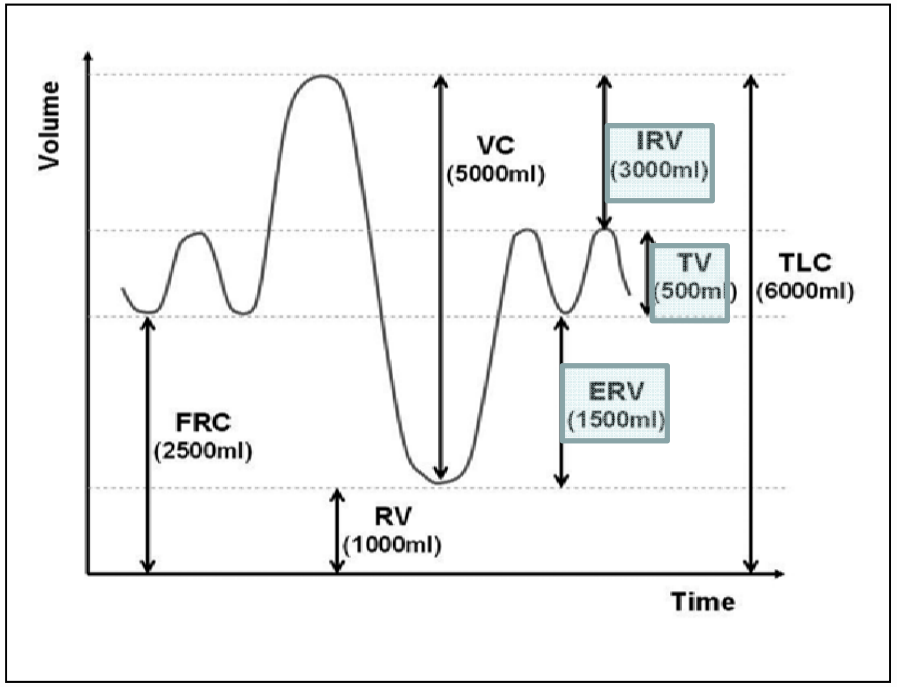
LUNG VOLUMES

- ***Tidal Volume* (TV):** volume of air inhaled or exhaled with each breath during quiet breathing (6-8 ml/kg) 500 ml
- ***Inspiratory Reserve Volume* (IRV):** maximum volume of air inhaled from the end-inspiratory tidal position.3000 ml
- ***Expiratory Reserve Volume* (ERV):** maximum volume of air that can be exhaled from resting end-expiratory tidal position.1500 ml



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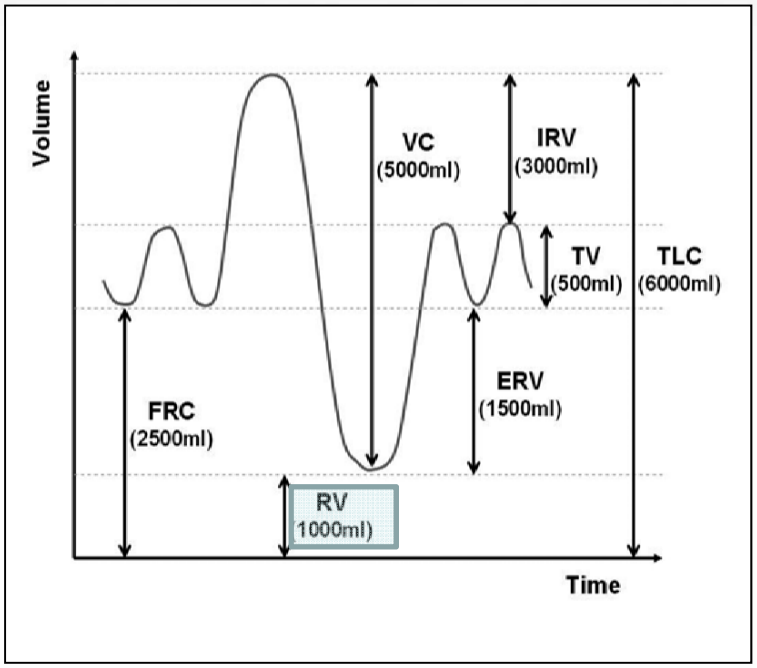
LUNG VOLUMES

- ***Residual Volume* (RV):**
  - Volume of air remaining in lungs after maximium exhalation (20-25 ml/kg) 1200 ml
  - Indirectly measured (FRC-ERV)
  - It can not be measured by spirometry .



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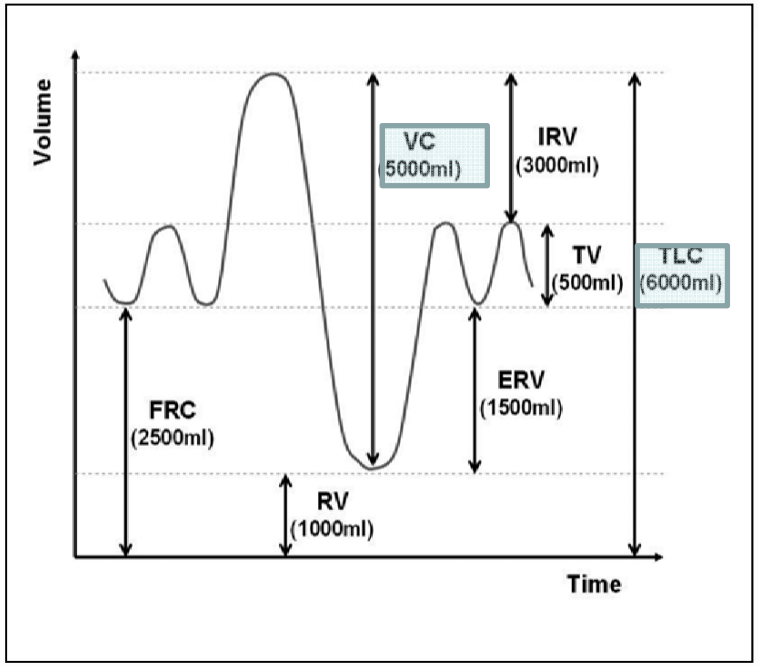
LUNG CAPACITIES

- ***Total Lung Capacity* (TLC):** Sum of all volume compartments or volume of air in lungs after maximum inspiration (4-6 L)
- ***Vital Capacity* (VC):** TLC minus RV or maximum volume of air exhaled from maximal inspiratory level. (60-70 ml/kg) 5000ml. VC ~ 3 TIMES TV FOR EFFECTIVE COUGH
- ***Inspiratory Capacity* (IC)**: Sum of IRV and TV or the maximum volume of air that can be inhaled from the end-expiratory tidal position. (2400-3800ml).
- ***Expiratory Capacity (EC)*:** TV+ ERV



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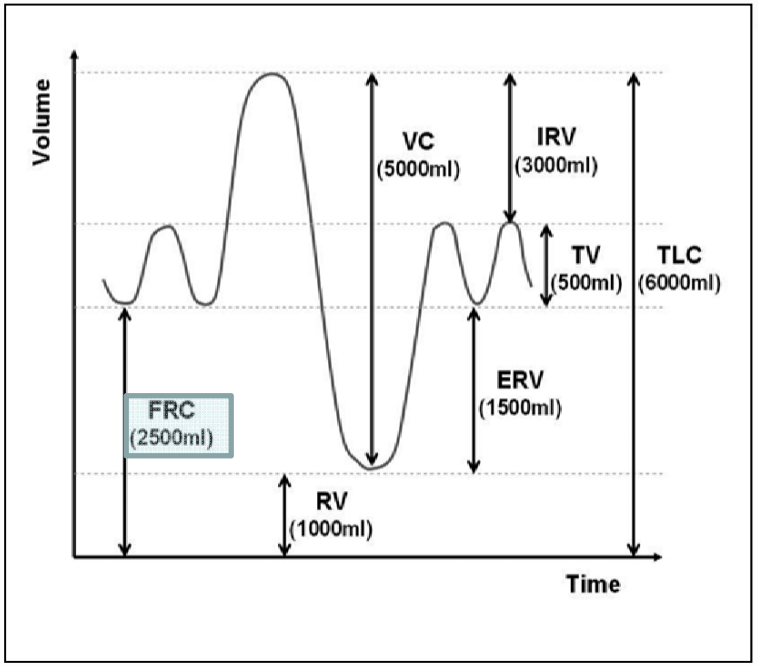
LUNG CAPACITIES

- ***Functional Residual Capacity* (FRC):**
  - Sum of RV and ERV or the volume of air in the lungs at end-expiratory tidal position.(30-35 ml/kg) 2500 ml
  - Decreases

1.in supine position(0.5-1L)

2.Obese pts

3.Induction of anesthesia: by 16-20%



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FUNCTION OF FRC

- Oxygen store
- Buffer for maintaining a steady arterial po2
- Partial inflation helps prevent atelectasis
- Minimizes the work of breathing

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Measuring RV, FRC

It can be measured by

- nitrogen washout technique
- Helium dilution method
- Body plethysmography

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N2 Washout Technique

- The patient breathes 100% oxygen, and all the nitrogen in the lungs is washed out.
- The exhaled volume and the nitrogen concentration in that volume are measured.
- The difference in nitrogen volume at the initial concentration and at the final exhaled concentration allows a calculation of intrathoracic volume, usually FRC.

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Helium Dilution technique

- Pt breathes in and out from a reservoir with known volume of gas containing trace of helium.
- Helium gets diluted by gas previously present in lungs.
- eg: if 50 ml Helium introduced and the helium concentration is 1% , then volume of the lung is 5L.

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Body Plethysmography

- Plethysmography (derived from greek word meaning enlargement).

- Based on principle of BOYLE'S LAW(P*V=k)
- Priniciple advantage over other two method is it quantifies non- communicating gas volumes.

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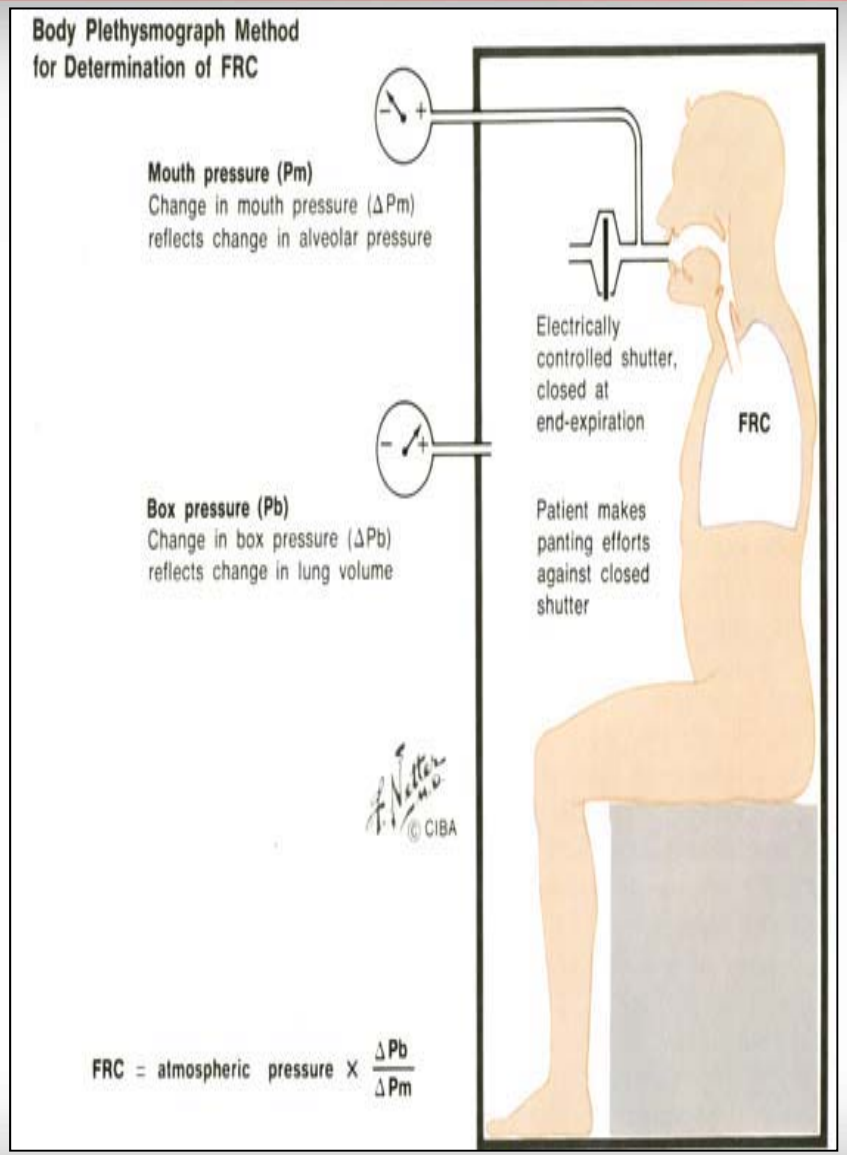
- A patient is placed in a sitting position in a closed body box with a known volume
- The patient pants with an open glottis against a closed shutter to produce changes in the box pressure proportionate to the volume of air in the chest.
- As measurements done at end of expiration, it yields FRC



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FORCED SPIROMETRY/TIMED EXPIRATORY SPIROGRAM

Includes measuring:

- pulmonary mechanics – to assess the ability of the lung to move large vol of air quickly through the airways to identify airway obstruction
- FVC
- FEV_1
- Several FEF values
- Forced inspiratory rates(FIF's)
- MVV

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FORCED VITAL CAPACITY

- The FVC is the maximum volume of air that can be breathed out as forcefully and rapidly as possible following a maximum inspiration.
- Characterized by full inspiration to TLC followed by abrupt onset of expiration to RV
- Indirectly reflects flow resistance property of airways.

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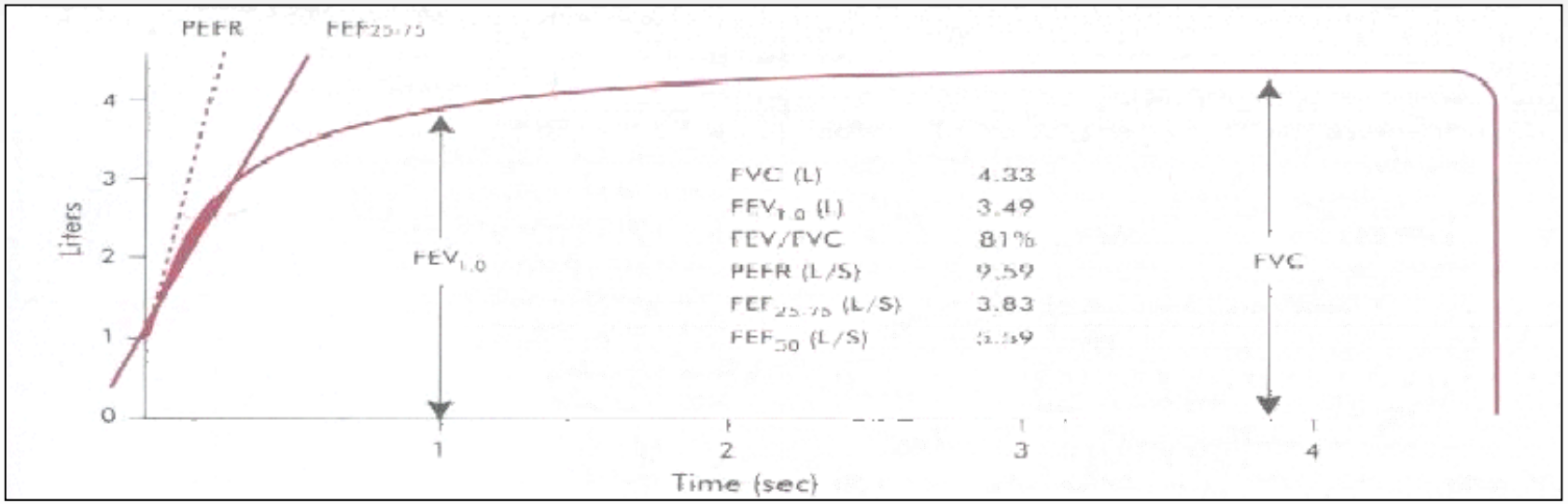
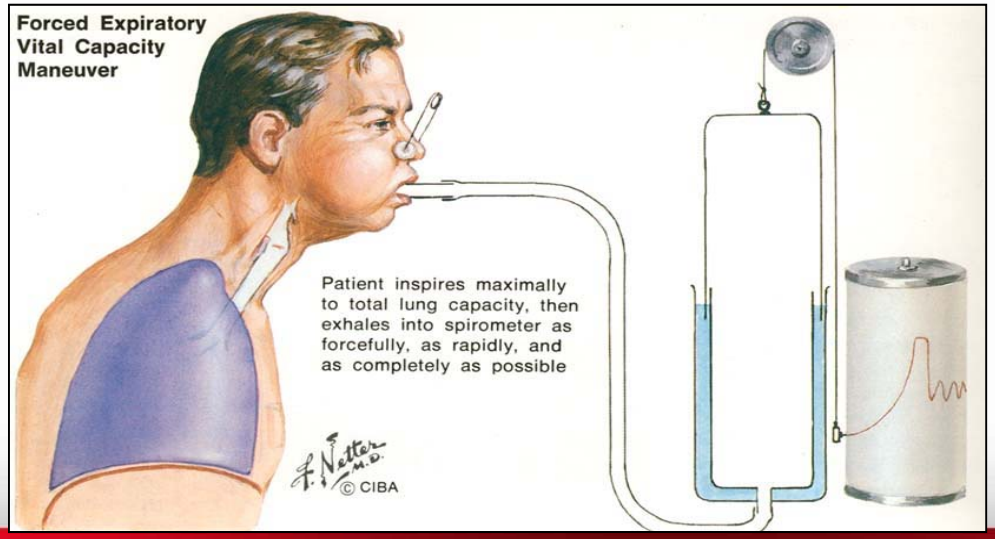
FORCED VITAL CAPACITY





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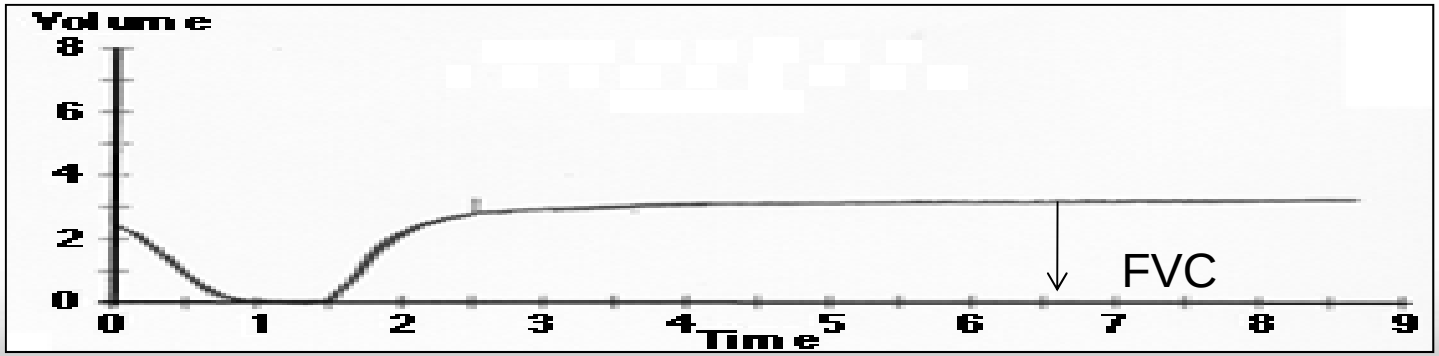
FVC

- Interpretation of % predicted:
  - 80-120% Normal
  - 70-79%
  - 50%-69% Moderate reduction
  - <50% Severe reduction

Mild reduction



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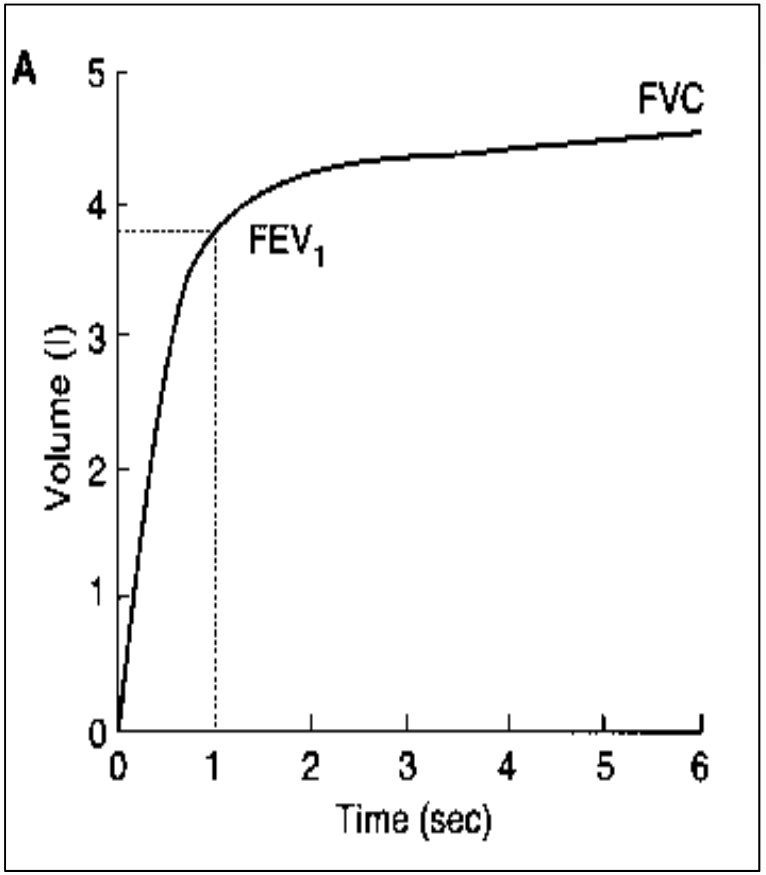
Measurements Obtained from the FVC Curve and their significance

- Forced expiratory volume in 1 sec(FEV_1)---the volume exhaled during the first second of the FVC maneuver.
- Measures <u>the general severity of the airway obstruction</u>
- Normal is 3-4.5 L



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Measurements Obtained from the FVC Curve and their significance

FEV1 – Decreased in both obstructive & restrictive lung disorders(if patient's vital capacity is smaller than predicted FEV1).

FEV1/FVC – Reduced in obstructive disorders.

Interpretation of % predicted:

- >75% Normal
- 60%-75% Mild obstruction
- 50-59% Moderate obstruction
- <49% Severe obstruction

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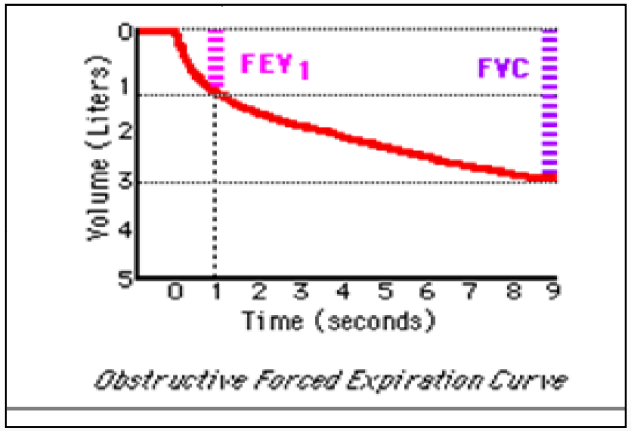
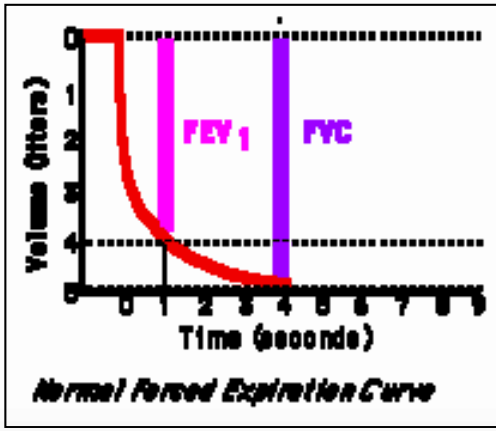
Measurements Obtained from the FVC Curve and their significance

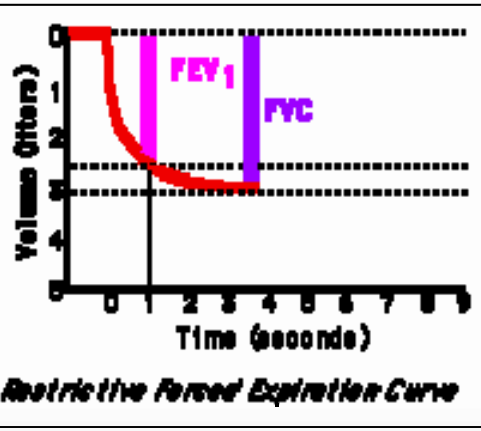
DISEASE STATES	FVC	FEV1	FEV1/FVC
1) OBSTRUCTIVE	↓	↓(smaller due to prolonged exp)	↓
2) STIFF LUNGS	↓	↓/normal	NORMAL
3) RESP. MUSCLE WEAKNESS	↓	↓	NORMAL



Obstructive Forced Expiration Curve



Normal Forced Expiration Curve



Restrictive Forced Expiration Curve

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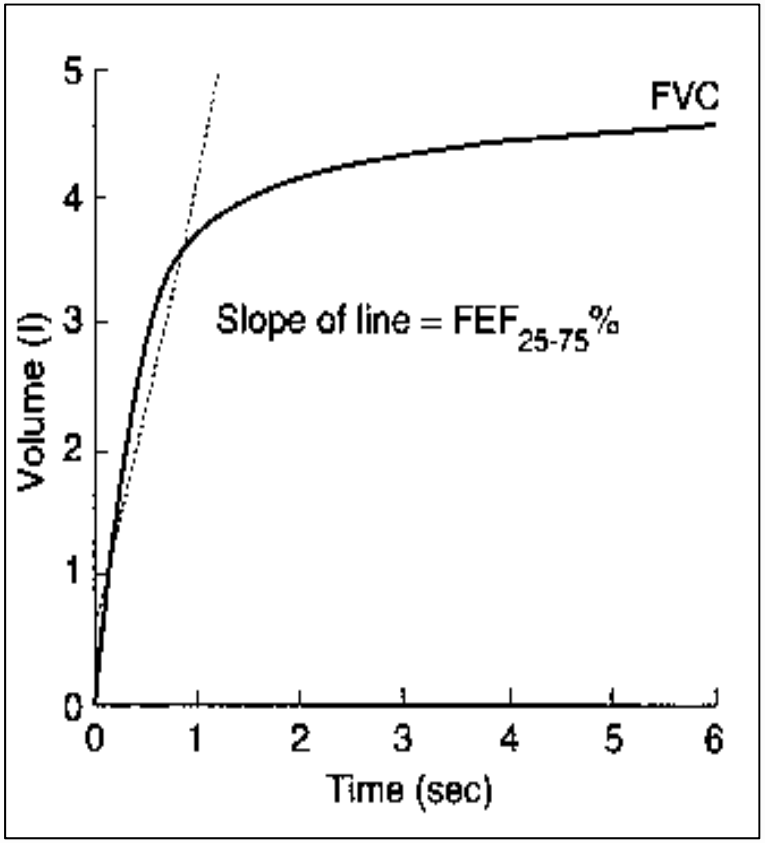
Forced midexpiratory flow 25-75% (FEF_{25-75})

- Max. Flow rate during the mid-expiratory part of FVC maneuver.
  - Measured in L/sec
  - May reflect effort independent expiration and the status of the small airways
  - Highly variable
  - Depends heavily on FVC
- N value – 4.5-5 l/sec. Or 300 l/min.



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Forced midexpiratory flow 25-75% (FEF_{25-75})

Interpretation of % predicted:

- >60% Normal
- 40-60% Mild obstruction
- 20-40% Moderate obstruction
- <10% Severe obstruction

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Peak expiratory flow rates

- Maximum flow rate during an FVC maneuver occurs in initial 0.1 sec
- After a maximal inspiration, the patient expires as forcefully and quickly as he can and the maximum flow rate of air is measured.
- Forced expiratory flow between 200-1200ml of FVC
- It gives a crude estimate of lung function, reflecting larger airway function.
- Effort dependant but is highly reproductive

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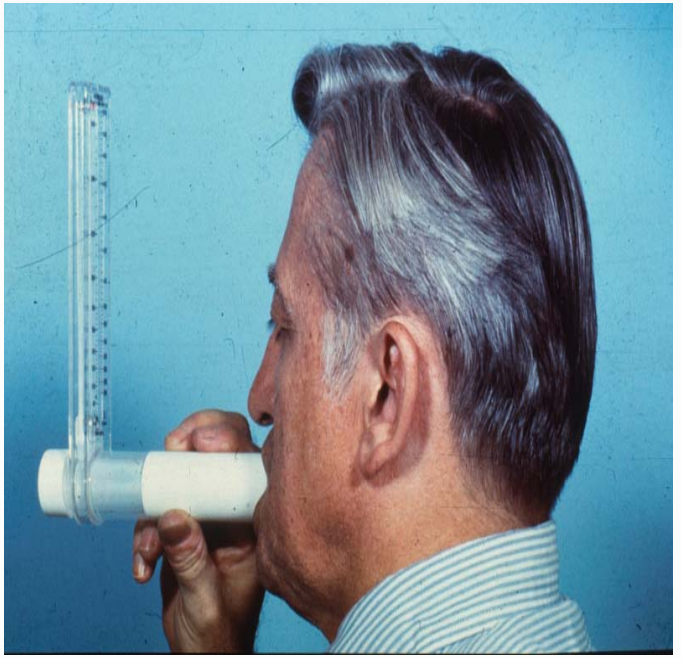
Peak expiratory flow rates

- It is measured by a peak flow meter, which measures how much air (litres per minute)is being blown out or by spirometry
- The peak flow rate in normal adults varies depending on age and height.
- Normal : 450 - 700 l/min in males

  300 - 500 l/min in females
- Clinical significance - values of <200/l- impaired coughing & hence likelihood of post-op complication



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Maximum Voluntary Ventilation (MVV) or maximum breathing capacity (MBC)

- Measures - speed and efficiency of filling & emptying of the lungs during increased respiratory effort
- Maximum volume of air that can be breathed in and out of the lungs in 1 minute by maximum voluntary effort
- It reflects *peak ventilation* in physiological demands
- *Normal : 150 -175 l/min.* It is FEV1 * 35
- <80% - gross impairment

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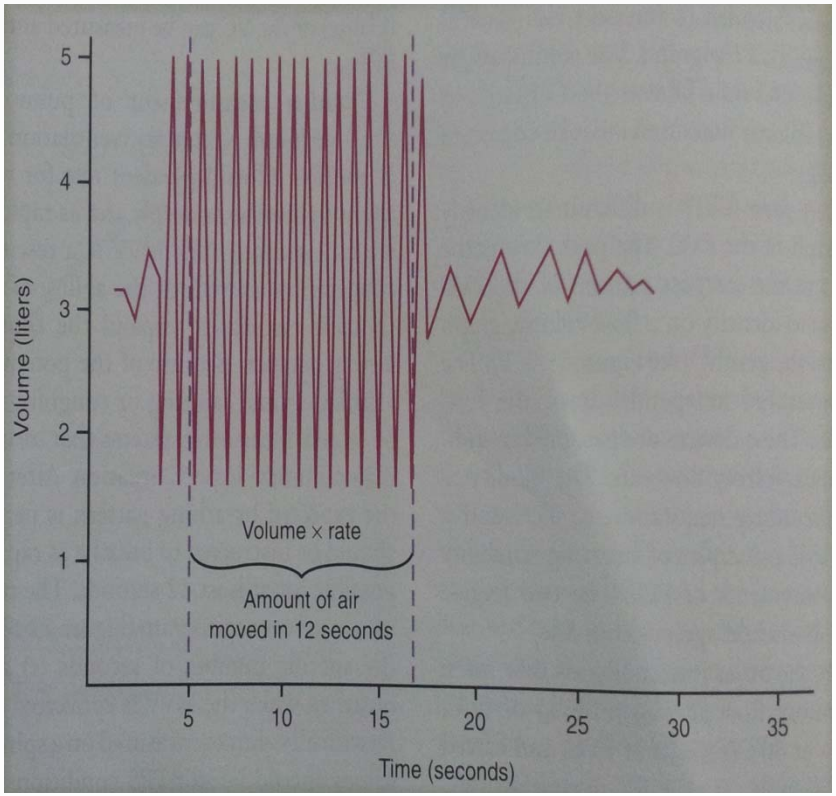
Maximum Voluntary Ventilation (MVV) or maximum breathing capacity (MBC)

- The subject is asked to breathe as quickly and as deeply as possible for 12 secs and the measured volume is extrapolated to 1min.
- Periods longer than 15 seconds should not be allowed because prolonged hyperventilation leads to fainting due to excessive lowering of arterial pCO_2 and H^+.
- MVV is markedly decreased in patients with

A. Emphysema

B. Airway obstruction

C. Poor respiratory muscle strength



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TO SUMMARISE

	OBSTRUCTIVE	RESTRICTIVE
Vital capacity	N or ↓	↓
Total lung capacity	N or ↑	↓
Residual volume	↑	↓
FEV1/FVC		N or ↑
Maximum mid expiratory flow rate	↓	N
Maximum breathing capacity	↓	N or ↓

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PHYSIOLOGICAL DETERMINANTS OF MAX. FLOW RATES

1)DEGREE OF EFFORT- driving pressure generated by muscle contraction (PEmax & PI max)

2) ELASTIC RECOIL PRESSURE OF LUNG: (PL)

- Tendency to recoil or collapse d/t PL
- PL increases from RV (2-3) to TLC (20-30)
- Opposed by Pcw (recoil pr. Of chest wall)
- Prs=Pl + Pcw = 0 at FRC-resting state

(Prs-recoil pr.of resp.system)

3) AIRWAY RESISTANCE (Raw):

- Determined by the calibre of airways
- Decreases as lung vol increases (hyperbolic curve)
- Raw high at RV & low at TLC

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FLOW VOLUME LOOPS

- "Spirogram" Graphic analysis of flow at various lung volumes
- Tracing obtained when a maximal forced expiration from TLC to RV is followed by maximal forced inspiration back to TLC
- Measures forced inspiratory and expiratory flow rate
- Augments spirometry results
- Principal advantage of flow volume loops vs. typical standard spirometric descriptions - *identifies the probable obstructive flow anatomical location.*

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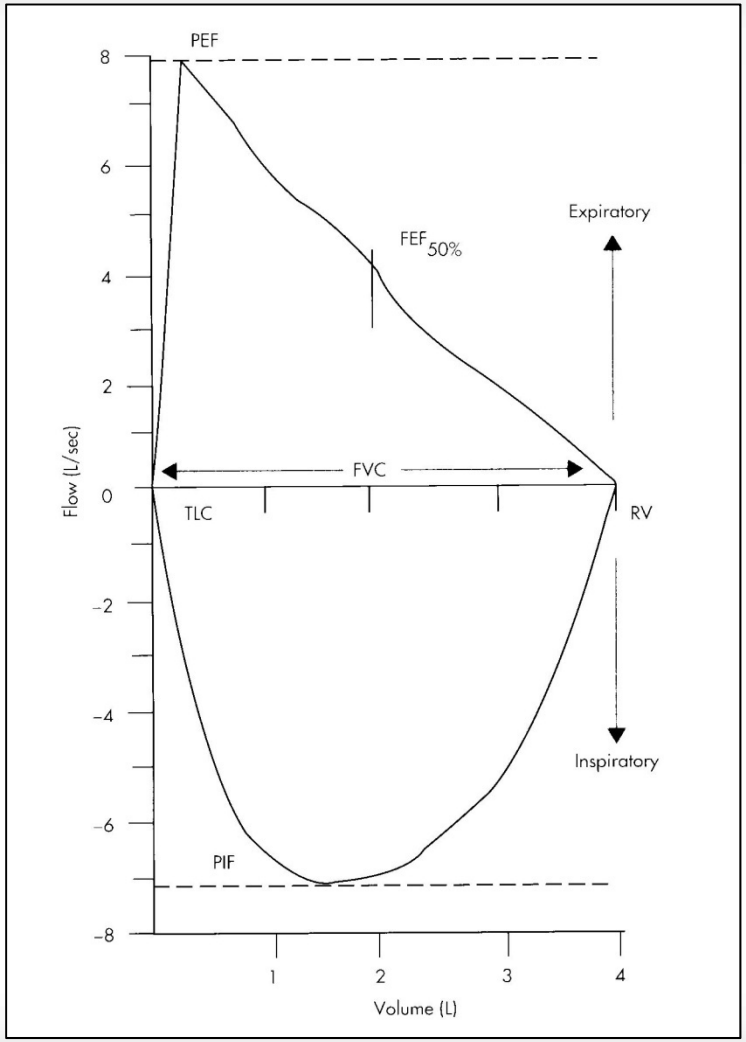
FLOW VOLUME LOOPS

- First 1/3rd of expiratory flow is effort dependent and the final 2/3rd near the RV is effort independent
- Inspiratory curve is entirely effort dependent
- Ratio of
  - maximal expiratory flow(MEF) /maximal inspiratory flow(MIF)
  - mid VC ratio and is normally 1



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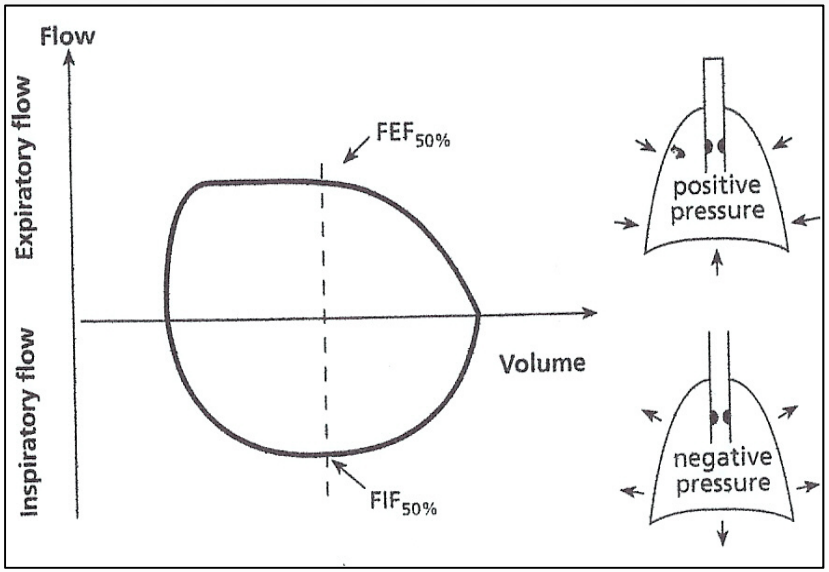
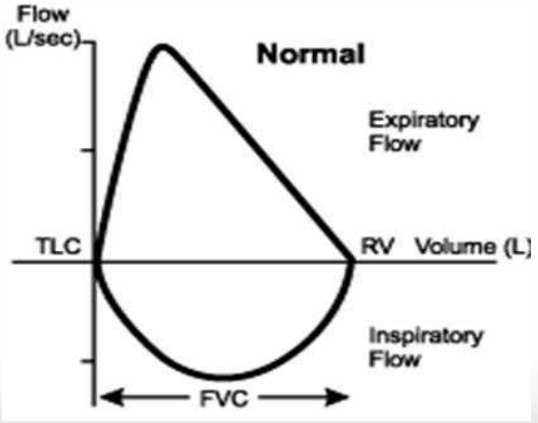
FLOW VOLUME LOOPS and DETECTION OF UPPER AIRWAY OBSTRUCTION

- flow-volume loops provide information on upper airway obstruction:

Fixed obstruction: constant airflow limitation on inspiration and expiration—such as

1. Benign stricture
2. Goiter
3. Endotracheal neoplasms
4. Bronchial stenosis





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FLOW VOLUME LOOPS and DETECTION OF UPPER AIRWAY OBSTRUCTION

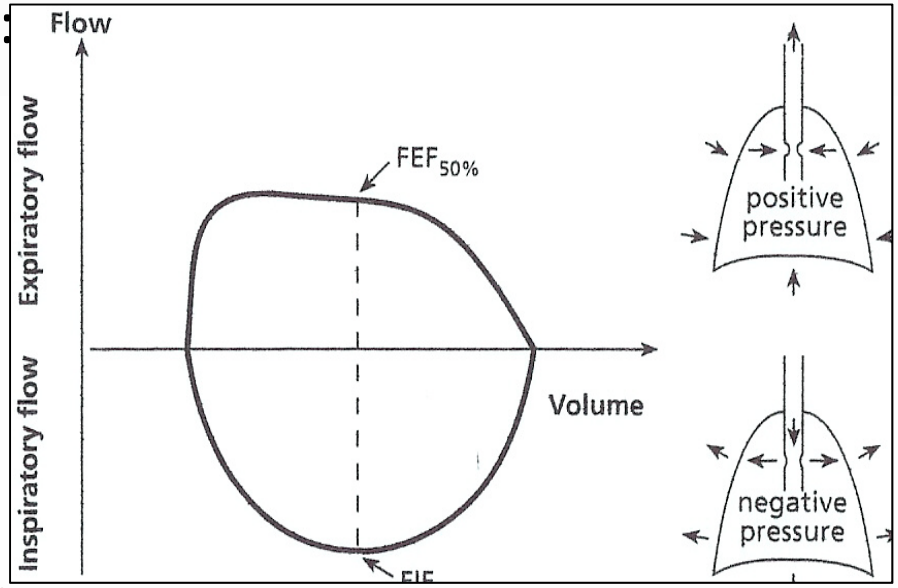
Variable intrathoracic obstruction:

flattening of expiratory limb.

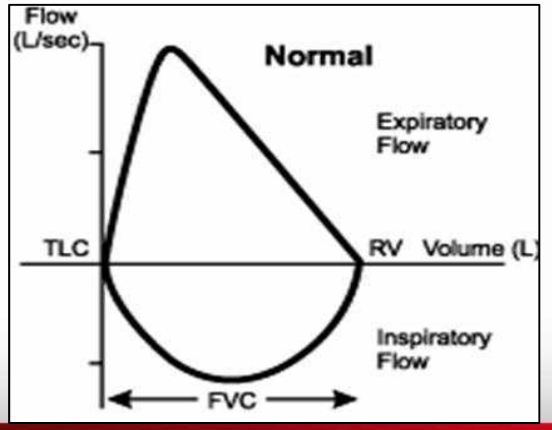
1.Tracheomalacia

2. Polychondritis

3. Tumors of trachea or main bronchus



- *During forced expiration – high pleural pressure – increased intrathoracic pressure - decreases airway diameter. The flow volume loop shows a greater reduction in the expiratory phase*
- *During inspiration – lower pleural pressure around airway tends to decrease obstruction*



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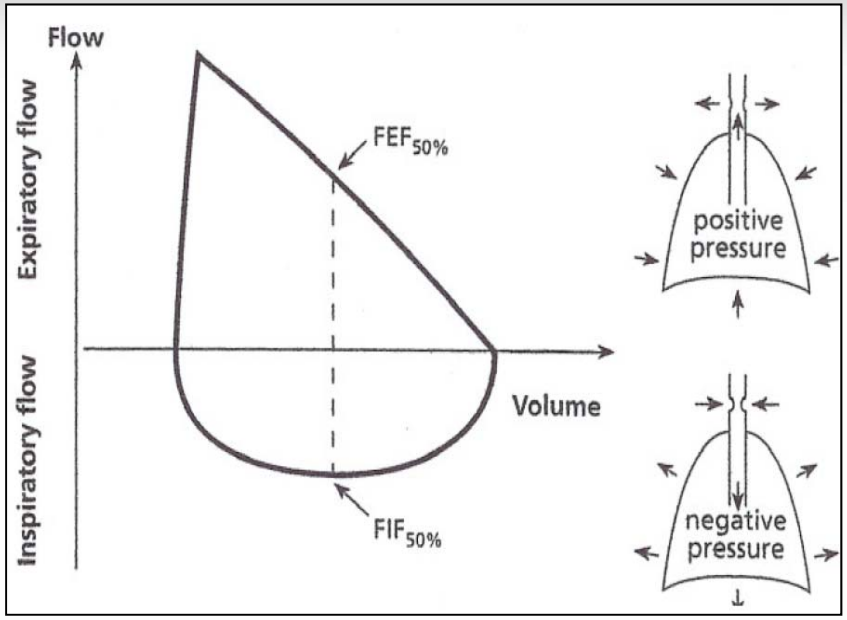
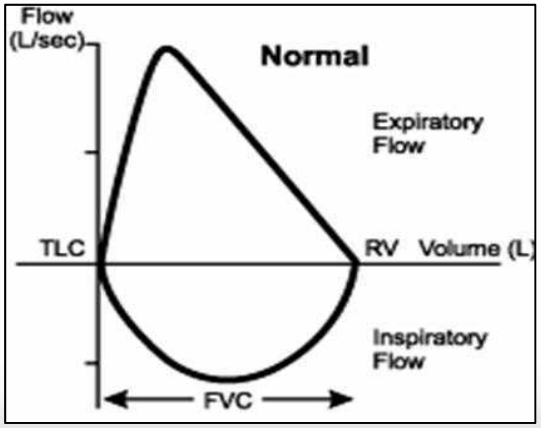
FLOW VOLUME LOOPS and DETECTION OF UPPER AIRWAY OBSTRUCTION

<u>Variable extrathoracic obstruction</u>:

1. Bilateral and unilateral vocal cord paralysis
2. Vocal cord constriction
3. Chronic neuromuscular disorders
4. Airway burns
5. OSA

- *<u>Forced inspiration- negative transmural pressure inside airway tends to collapse it</u>*
- *<u>Expiration – positive pressure in airway decreases obstruction</u>*
- *<u>inspiratory flow is reduced to a greater extent than expiratory flow</u>*





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Obstructive Pattern — Evaluation

Common obstructive lung diseases

- Asthma
- COPD (chronic bronchitis, emphysema)
- Cystic fibrosis

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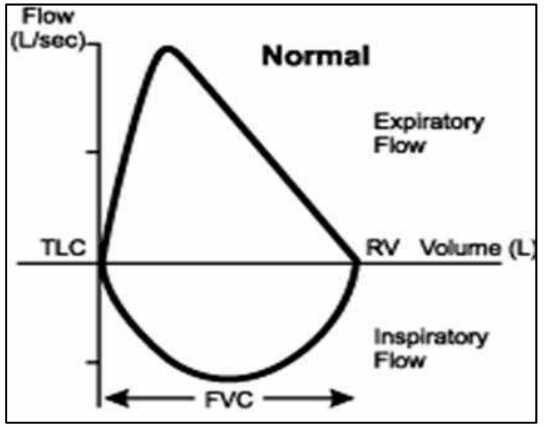
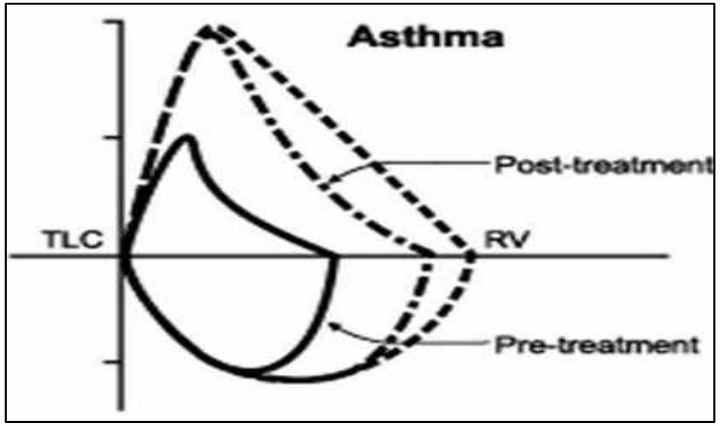
ASTHMA

- Peak expiratory flow reduced so maximum height of the loop is reduced
- Airflow reduces rapidly with the reduction in the lung volumes because the airways narrow and the loop become concave
- Concavity may be the indicator of airflow obstruction and may present before the change in FEV1 or FEV1/FVC





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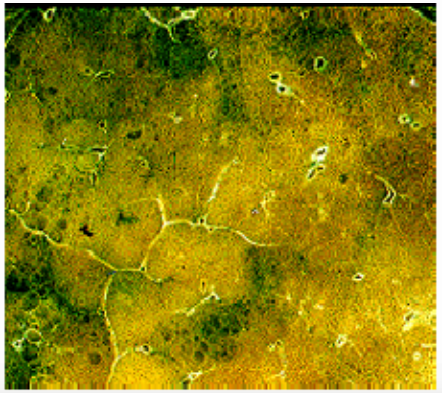
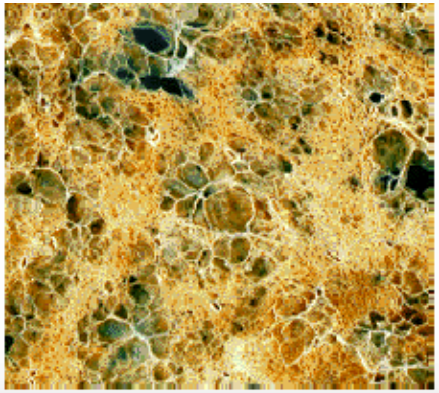
EMPHYSEMA

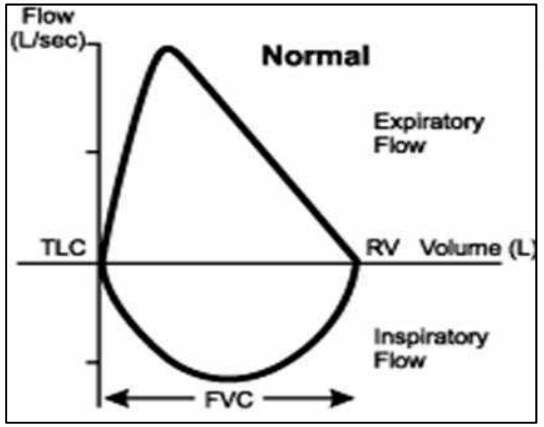
- Airways may collapse during forced expiration because of destruction of the supporting lung tissue causing very reduced flow at low lung volume and a characteristic (dog-leg) appearance to the flow volume curve

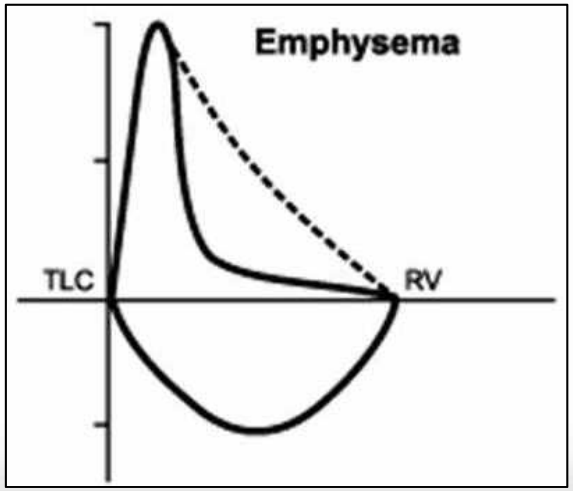


Normal Lung - Gross



Emphysemic Lung - Gross





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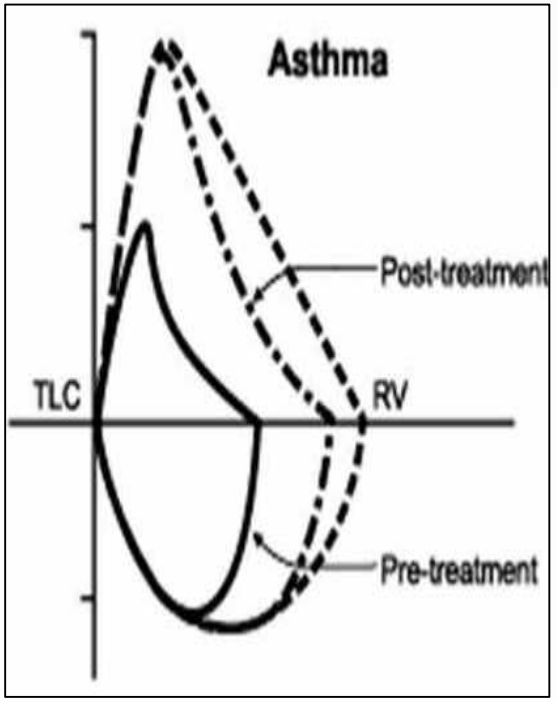
REVERSIBILITY

- Improvement in FEV1 by 12-15% or 200 ml in repeating spirometry after treatment with Sulbutamol 2.5mg or ipratropium bromide by nebuliser after 15-30 minutes
- Reversibility is a characterestic feature of B.Asthma
- In chronic asthma there may be only partial reversibility of the airflow obstruction
- While in COPD the airflow is irreversible although some cases showed significant improvement



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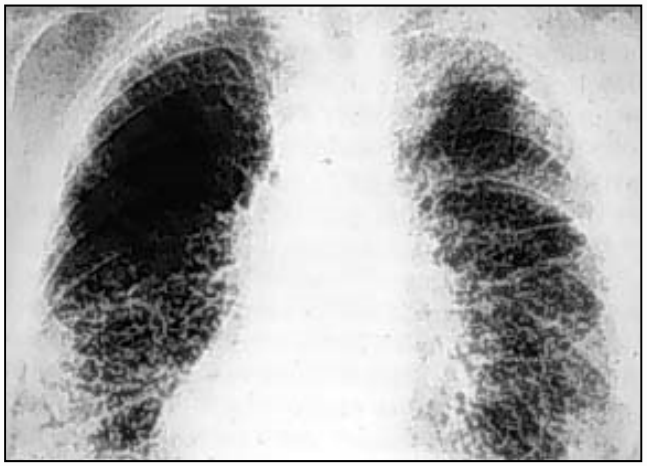
RESTRICTIVE PATTERN

Characterized by reduced lung volumes/decreased lung compliance

Examples*:*

- Interstitial Fibrosis
- Scoliosis
- Obesity
- Lung Resection
- Neuromuscular diseases
- Cystic Fibrosis



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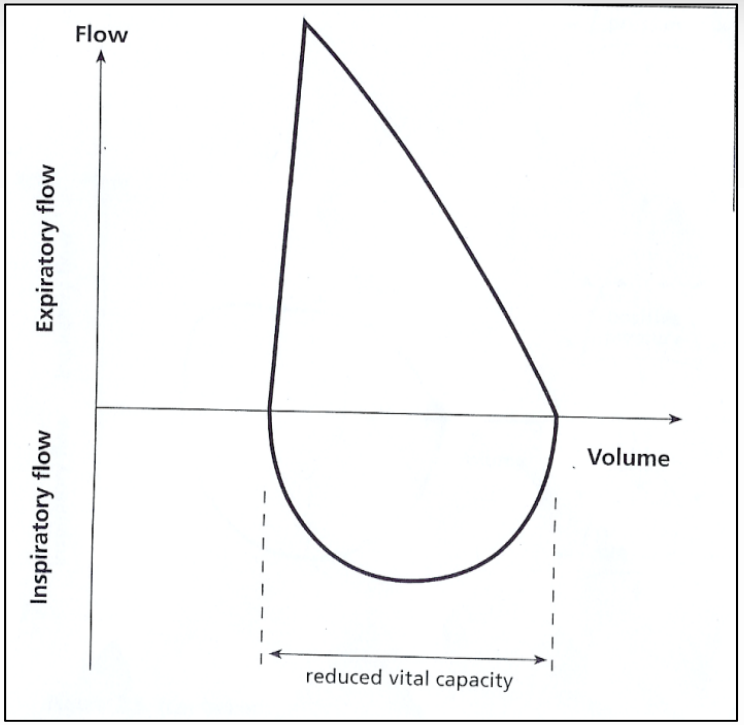
RESTRICTIVE PATTERN-flow volume loop

- low total lung capacity
- low functional residual capacity
- low residual volume.
- Forced vital capacity (FVC) may be low; however, FEV_1/FVC is often normal or greater than normal due to the increased elastic recoil pressure of the lung.
- Peak expiratory flow may be preserved or even higher than predicted leads to tall,narrow and steep flow volume loop in expiratory phase.



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TESTS FOR GAS EXCHANGE FUNCTION

ALVEOLAR-ARTERIAL O2 TENSION GRADIENT:

- Sensitive indicator of detecting regional V/Q inequality
- N value in young adult at room air = 8 mmHg to up to 25 mmHg in 8^{th} decade (d/t decrease in PaO2)
- AbN high values at room air is seen in asymptomatic smokers & chr. Bronchitis (min. symptoms)

A-a gradient = PAO2 - PaO2

* PAO2 = alveolar PO2 (calculated from the alveolar gas equation)
* PaO2 = arterial PO2 (measured in arterial gas)

PAO2:

(PB - PH2O)*FiO2 - (PaCO2/RQ)

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TESTS FOR GAS EXCHANGE FUNCTION

DIFFUSING CAPACITY

- Rate at which gas enters the blood divided by its driving pressure (gradient – alveolar and end capillary tensions)
- Measures ability of lungs to transport inhaled gas from alveoli to pulmonary capillaries
- Normal- 20-30 ml/min/mm Hg
- Depends on:
    - thickeness of alveolar—capillary membrane
    - hemoglobin concentration
    - cardiac output

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TESTS FOR GAS EXCHANGE FUNCTION

SINGLE BREATH TEST USING CO

- Pt inspires a dilute mixture of CO and hold the breath for 10 secs.
- CO taken up is determined by infrared analysis:
- $$DlCO = \frac{CO\ ml/min/mmhg}{PACO - PcCO}$$
- DLO2 = DLCO x 1.23
- Why CO?

A) High affinity for Hb which is approx. 200 times that of O2 , so does not rapidly build up in plasma

B) Under N condition it has low bld conc ≈ 0

C) Therefore, pulm conc.≈0

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FACTORS EFFECTING DLCO

DECREASE(< 80% predicted)	INCREASE(> 120-140% predicted)
Anemia	Polycythemia
Carboxyhemoglobin	Exercise
Pulmonary embolism	Congestive heart failure
Diffuse pulmonary fibrosis	
Pulmonary emphysema	

Predicted DLCO for Hb= Predicted DLCO * (1.7 Hb/10.22 + Hb)

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CARDIOPULMONARY INTERACTION

- **Stair climbing and 6-minute walk test**
- This is a simple test that is easy to perform with minimal equipment. Interpretated as in the following table:

Performance	VO2 max(ml/kg/min)	Interpretation
>5 flight of stairs	> 20	Low mortality after pneumonectomy, FEV1>2l
>3 flight of stairs		Low mortality after lobectomy, FEV1>1.7l
<2 flight of stairs		Correlates with high mortality
<1 flight of stairs	<10	
6 min walk test <600 m	<15	

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CARDIOPULMONARY INTERACTION

- **Shuttle walk**
- The patient walks between cones 10 meters apart with increasing pace.
- The subject walks until they cannot make it from cone to cone between the beeps.
- Less than 250m or decrease SaO2 > 4% signifies high risk.
- A shuttle walk of 350m correlates with a VO2 max of 11ml.kg-1.min-1

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Cardiopulmonary Exercise Testing

- Non invasive technique
- Effort independent
- To test ability of subjects physiological response to cope with metabolic demands

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Basic Physiological Principles

- Exercising muscle gets energy from 3 sources- stored energy (creatine phosphate), aerobic metabolism of glucose, anaerobic metabolism of glucose
- In exercising muscle when oxygen demand exceeds supply- lactate starts accumulating- *lactate anaerobic threshold (LAT)*
- With incremental increase in exercise – expired minute volume, oxygen consumption per minute, CO2 production per minute increases

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What To Measure

- Anaerobic threshold (> 11 ml/kg/min)
- Maximum oxygen utilization VO2 (>20ml/kg/min)
- Ventilatory equivalent of O2 (< 35L)
- Ventilatory equivalent of CO2 (<42L)
- Oxygen pulse (4-6ml/heart beat)

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Assessment of lung function in thoracotomy pts

- As an anesthesiologist our goal is to :

1) to identify pts at risk of increased post-op morbidity & mortality

2) to identify pts who need short-term or long term post-op ventilatory support.

Lung resection may be f/by – inadequate gas exchange, pulm HTN & incapacitating dyspnoea.

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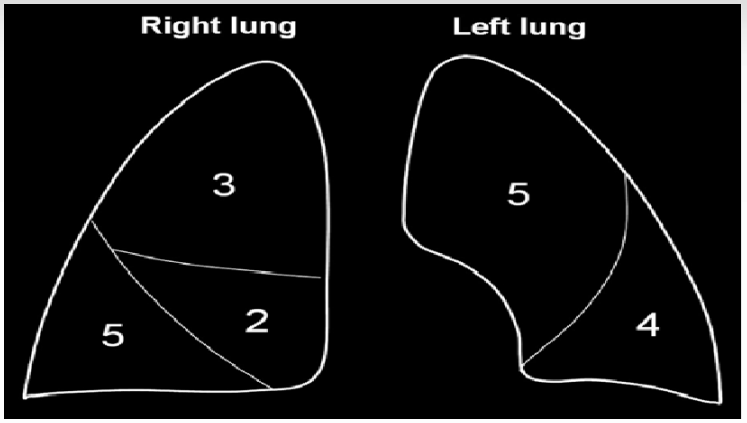
Assessment of lung function in thoracotomy pts



Calculating the predicted postoperative FEV1 (ppoFEV1) and TLCO (ppoTLCO):

There are 5 lung lobes containing 19 segments in total with the division of each lobe.

$$\text{Ppo FEV1} = \text{preoperative FEV1} * \frac{\text{no. of segments left after resection}}{19}$$

- Can be assessed by ventilation perfusion scan. For eg:

A 57-year-old man is booked for lung resection. His CT chest show a large RUL mass confirmed as carcinoma:
ppoFEV1= 50*16/19=42%

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Assessment of lung function in thoracotomy pts

ppoFEV1(% predicted)	Interpretation
> 40	No or minor respiratory complications anticipated
< 40	Likely to require postoperative ventilation/increased risk of death/complication
< 30	Non surgery management should be considered

ppoDLCO(% predicted)	Interpretation
> 40,ppoFEV1> 40%,SaO2>90% on air	Intermediate risk , no further investigation needed
< 40	Increased respiratory and cardiac morbidity
< 40 and ppoFEV1<40%	High risk- require cardiopulmonary exercise test

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In addition to history , examination , chest X- ray, PFT's pre- op evaluation includes:

- ventilation perfusion scintigraphy/ CT scan

- split-lung function tests

➢ methods have been described to try and simulate the postoperative respiratory situation by unilateral exclusion of a lung or lobe with an endobronchial tube/blocker or by pulmonary artery balloon occlusion of a lung or lobe artery

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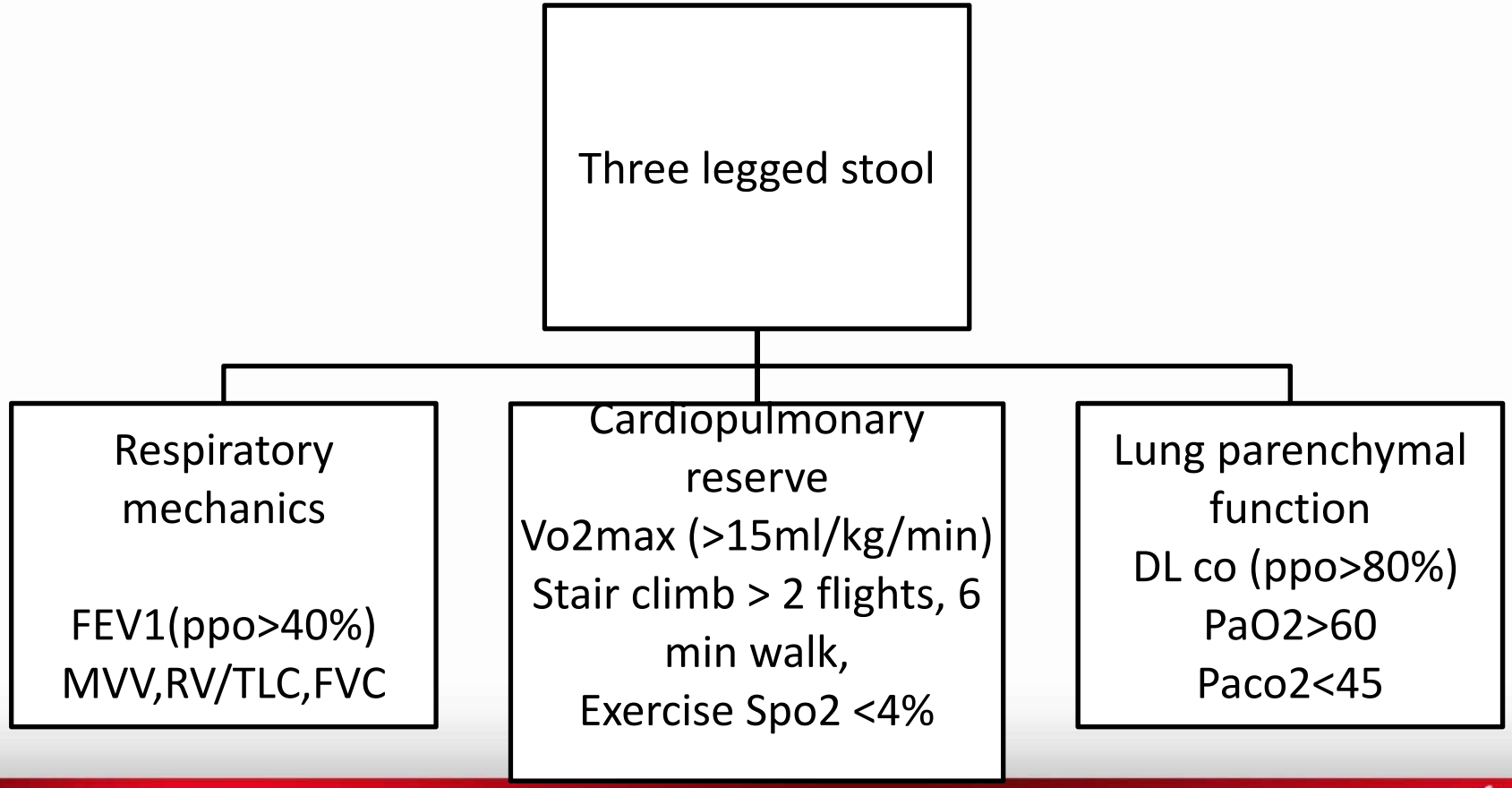
Combination tests

- There is no single measure that is a ‘Gold standard ‘ in predicting post-op complications



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Pulmonary function criteria suggesting increased risk of post-operative pulmonary complications for various surgeries

Parameters	Abdominal	Thoracic
FVC	< 70 % predicted	< 2 lit. or < 70% predicted
FEV1	< 70 % predicted	< 2 lit. – pneumonectomy < 1 lit. – lobectomy < 0.6 lit. – wedge or segmentectomy
FEV1/FVC	< 65 % predicted	< 50 % predicted
FEF 25-75 %	< 50 % predicted	< 1.6 lit. – pneumonectomy < 0.6 lit.- lobectomy/segmentectomy
MVV/MBC	< 50 % predicted	< 50 % predicted
PaCO2	> 45 mm Hg	> 45 mm Hg

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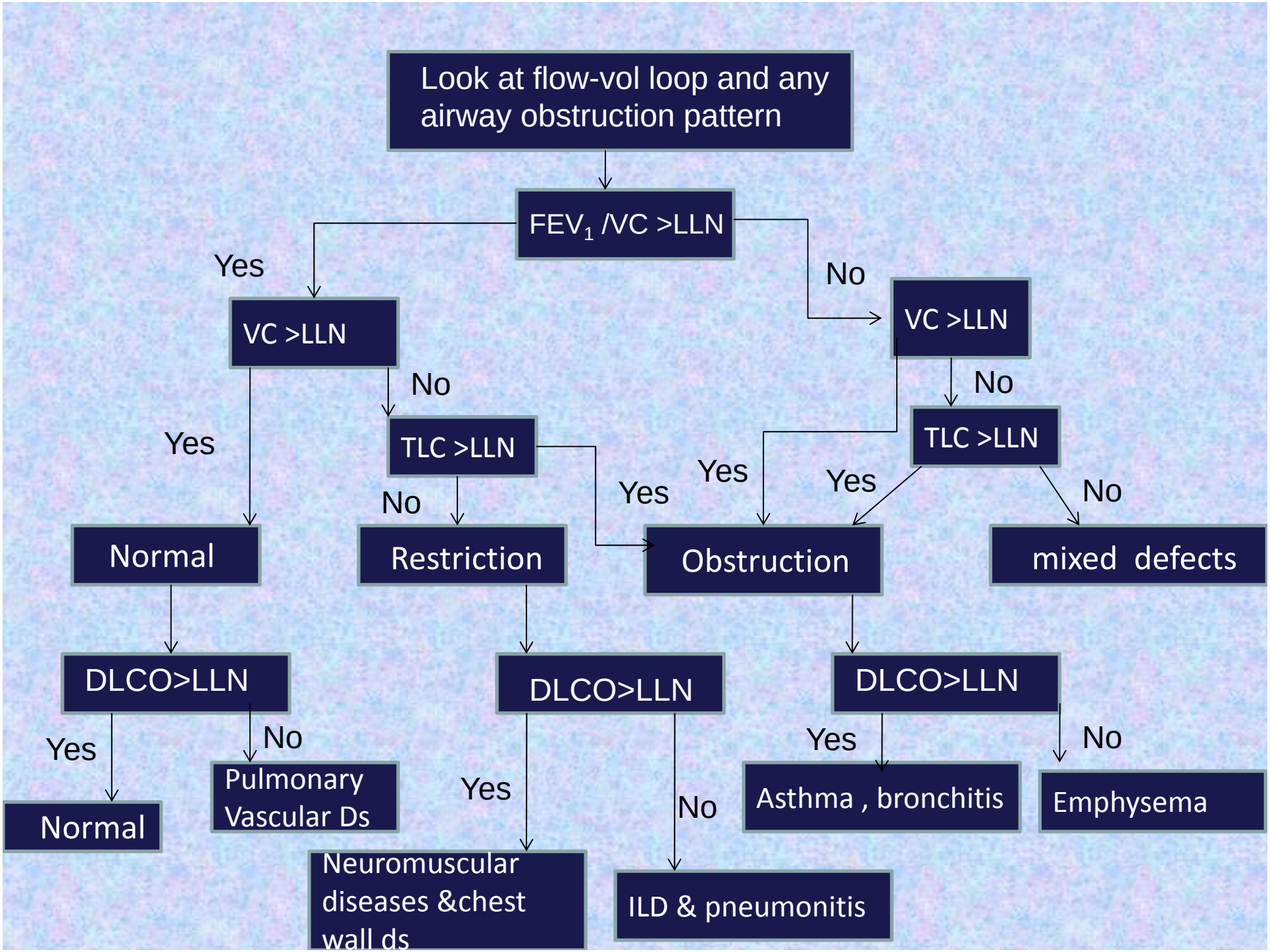
Look at flow-vol loop and any airway obstruction pattern
FEV1 /VC >LLN
Yes
No
VC >LLN
VC >LLN
No
No
Yes
TLC >LLN
TLC >LLN
Yes
Yes
Yes
No
No
Normal
Restriction
Obstruction
mixed defects
DLCO>LLN
DLCO>LLN
DLCO>LLN
Yes
No
Yes
No
Yes
No
Normal
Pulmonary Vascular Ds
Neuromuscular diseases &chest wall ds
ILD & pneumonitis
Asthma , bronchitis
Emphysema

Yes, PFTs are really wonderful but… They do not act alone.

- They act only to support or exclude a diagnosis.
- A combination of a thorough history and physical exam, as well as supporting laboratory data and imaging is helpful in developing a anaesthetic plan for pt with pulmonary dysfunction.

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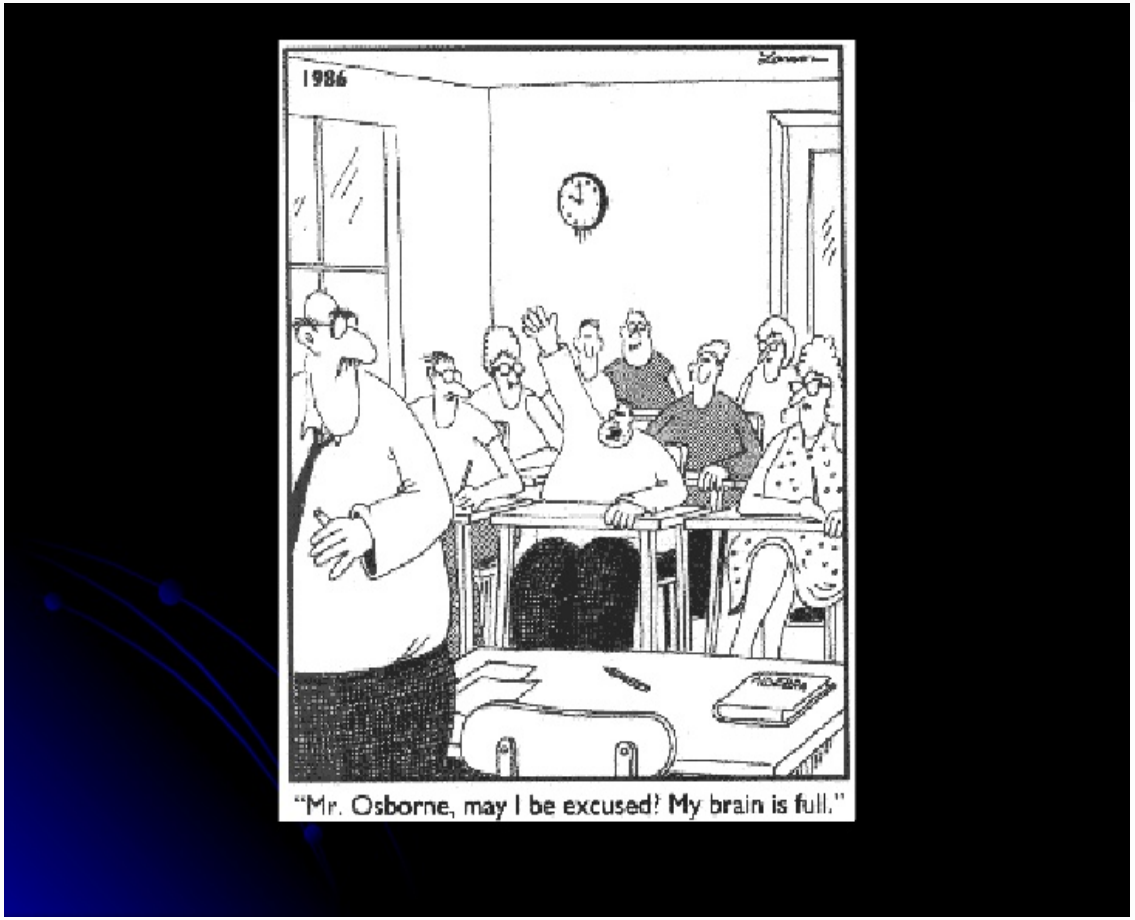
THANK YOU



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